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(54) **Use of ursolic acid for the manufacture of a medicament for suppressing metastasis**

(57) Ursolic acid or a pharmacologically acceptable salt is the active ingredient in a metastasis suppressory

composition to be administered to patients per os or by injection.

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## Description

The present invention relates to metastasis suppressory agents which show reduced side effects.

One of the greatest difficulties encountered in surgical therapies of cancers is post-operative recurrence. In many cases, metastasis is the primary cause of such recurrence. Metastasis involves a series of complex reactions, inclusive of separation of cancer cells from the primary nidus, followed by infiltration into the surrounding tissues, and proliferation at distant sites of the body to thereby form secondary, metastasized nidi.

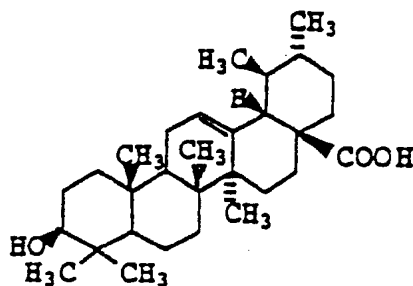
Cancer cells, even after separation from primary nidus, are hindered from further spreading by nearby existing extracellular matrix composed of sugar proteins, such as various collagens, fibronectins and laminins, and proteoglycans. Cancer cells, on the other hand, cleave and degrade the extracellular matrix structure and migrate, while taking full advantage of a variety of proteases and glycosidases secreted by themselves or the interstitium cells.

Cancer cells having separated in this manner from the primary nidus invade the vasculature, then travel to distant organs, infiltrate into the basement membrane of vascular endothelia and finally lodge in distant tissues for proliferation.

Consequently, suppression of metastasis is of great importance as a cancer therapy. For this purpose, there have so far been developed various metastasis suppressory agents, such as platelet aggregation suppressory agents, matrix metalloproteinase inhibitors and adhesion-factor suppressory agents. Nevertheless, these do not provide an effective means for suppressing metastasis.

It is an object of the present invention to provide a metastasis suppressory agent which has reduced side effects, increased safety and higher metastasis suppressory activity than conventionally used chemotherapy drugs.

The present inventors have discovered that ursolic acid (represented by the below-shown chemical formula), which is widely distributed in various species of plants, such as apple, persimmon and pear, can suppress metastasis by oral or intravenous administration:



The present invention is concerned with metastasis suppressory agents which comprise ursolic acid or its salt as an active ingredient.

Ursolic acid may be in the form of the free acid or a pharmaceutically acceptable salt, such as sodium and potassium salts. Unless otherwise apparent from the context, the term "ursolic acid" used herein includes salts as well as the free acid.

Ursolic acid can be administered to adult patients at a daily dose in the range of 10 mg to 3,000 mg, preferably about 500 mg, *per os*, or parenterally, for example, by such means as injection, if desired.

Ursolic acid may be administered to patients directly as such or after being processed into a suitable dosage form. Specific examples of such dosage form include pharmaceutical preparations for internal use, such as conventional powders, granules, tablets, capsules and liquids (inclusive of syrups), and these pharmaceutical preparations can be produced following conventional procedures by incorporating ursolic acid with conventionally used additives. In the case of pharmaceutical preparations for internal use, employable as such additives are conventional ingredients or components for pharmaceutical preparations, such as excipients (e.g., starch and lactose), binders (e.g., celluloses and polyvinylpyrrolidone), disintegrating agents (e.g., carboxymethylcellulose), lubricants (e.g., magnesium stearate), coating agents (e.g., hydroxyethylcellulose), flavoring agents, coloring agents, preservatives and emulsifiers.

Ursolic acid is a kind of triterpene and, with its low toxicity, can safely be administered to patients, as may be evidenced by the facts that it does not exert any adverse effect on the proliferation of cultured cells *in vitro* and that it is in wide use as a drug or an emulsifier for food use.

Ursolic acid exhibits satisfactory metastasis suppressory activity, as is evident from the test examples described below, and can be used as a metastasis suppressory agent against a variety of cancers, such as malignant melanoma, hystero myoma, esophageal carcinoma, skin cancer, stomach cancer, pulmonary carcinoma, cancers of the small and large intestines, pancreatic carcinoma, breast cancer and vesical carcinoma, as well as malignant tumors, such as choriocarcinoma, brain tumor, lymphatic sarcoma and leukemia.

Below described are Examples to illustrate the present invention in more detail.

### Test Example 1

#### Effect of ursolic acid on the proliferation of cultured cells:

##### (a) Test method

Human normal fibroblast cells and B16 F10 malignant melanoma in suspension ( $5 \times 10^4$  cells) were cultivated for 2 days, and then for 24 hours in the presence of 0.1  $\mu\text{M}$  and 1  $\mu\text{M}$  of ursolic acid and in the absence of the same, respectively. The cells were harvested, and their numbers were counted to determine the effect of ursolic acid on cell proliferation.

##### (b) Test results

Shown in Table 1 are the test results, which indicate that ursolic acid did not exert any effect on the proliferation of melanoma cells at concentrations of 1  $\mu\text{M}$  and 0.1  $\mu\text{M}$ .

Table 1

Effects of ursolic acid on the cultured cells:		
Concentration of ursolic acid ( $\mu\text{M}$ )	Rate of proliferation (%)	
	Human fibroblast cell	Malignant melanoma cell
0.1	101.3	98.4
1	99.5	117.7

Note: The proliferation rate (%) is expressed as the ratio of a number of proliferated cells treated with ursolic acid against a number of proliferated cells not treated with ursolic acid.

### Example 1

Pharmaceutical preparations for metastasis suppression were prepared in accordance with the following formulations:

#### Preparation for internal use:

Ursolic acid	300 mg
Sodium carboxymethylcellulose	50 mg
Purified water	To make the total to 10 ml

#### Injectable solution:

Ursolic acid	250 mg
Sesame oil	to make the total to 5 ml

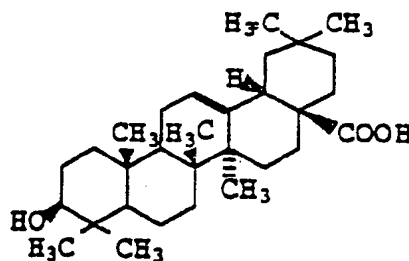
### Example 2:

#### Test in mice on the suppression of metastasis of malignant melanoma:

##### (a) Test method

A suspension of B16 F10 malignant melanoma cells was given intravenously to groups of mice each consisting of 10 animals. During the period of Days 7 to 13 after injection of melanoma cells, the internal preparation containing ursolic acid was administered to the relevant group of mice orally once a day, while the injectable solution was applied to the relevant group of mice intraperitoneally once a day. The lungs were removed on Day 14 to examine each group for the number of metastasized nidi lodged in the lungs. The same test was carried out with oleanolic acid (represented by the following chemical formula) which has the 29-position methyl group of ursolic acid in a

different position and which also belongs to the same five-ring triterpenes as ursolic acid.



#### (b) Test results

Tabulated in Table 2 are the results of the above test, which reveal that ursolic acid, after intraperitoneal and oral administration, reduced significantly the metastasis in the lungs of melanoma cells, as compared with the control group not treated with ursolic acid.

On the other hand, oleanolic acid, even when dosed at 300 mg/kg, did not exhibit significant suppression of metastasis.

Table 2

Results of suppression of metastasis by ursolic or oleanolic acid			
Drug substance	Dose (mg/kg)	Route of administration	Rate of metastasis suppression (%)
Control	-	-	0
Ursolic acid	100	Intraperitoneal	66.2**
Ursolic acid	100	<u>per os</u>	58.7*
Oleanolic acid	300	<u>per os</u>	14.5

Note: A test of significance;

\*  $p < 0.10$  against control group.

\*\*  $p < 0.05$  against control group

#### Claims

1. A pharmaceutical composition for oral or parenteral administration comprising ursolic acid or a pharmacologically acceptable salt thereof in a metastasis suppressory amount.
2. A composition as claimed in Claim 1, wherein the ursolic acid or salt thereof is present in an amount sufficient to provide a daily dose in the range of 10 mg to 3,000 mg for adult patients.
3. A composition as claimed in Claim 1 or Claim 2, wherein the ursolic acid or salt thereof is the sole active ingredient.
4. A composition as claimed in any one of the preceding claims, wherein the ursolic acid is in free acid form.
5. The use of ursolic acid or a pharmacologically acceptable salt thereof in the manufacture of a medicament for the suppression of metastasis.
6. The use as claimed in Claim 5, wherein the ursolic acid or salt thereof is the sole active ingredient in the medicament.
7. The use as claimed in Claim 5 or Claim 6, wherein the ursolic acid is in free acid form.
8. The use as claimed in any one of Claim 5 to 7, wherein the medicament is for oral administration.

9. The use as claimed in any one of Claim 5 to 7, wherein the medicament is for parenteral administration.

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## EUROPEAN SEARCH REPORT

Application Number  
EP 96 30 8340

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	BE-A-707 409 (SIPHAR SA) * page 2, paragraph 6 - page 3, paragraph 1; claims 1-5 *	1,3,4	A61K31/19
X	--- DATABASE WPI Section Ch, Week 9206 Derwent Publications Ltd., London, GB; Class A96, AN 92-044319 XP002024791 & JP-A-03 287 530 (SNOW BRAND MILK PRODUCTS), 18 December 1991 * abstract *	1-4	
X	--- DATABASE WPI Section Ch, Week 8912 Derwent Publications Ltd., London, GB; Class B05, AN 89-089693 XP002024792 & JP-A-01 039 973 (TAIYO KAGAKU KK), 10 February 1989 * abstract *	1-4	
Y	--- CANCER LETTERS, vol. 94, no. 2, 1995, pages 213-218, XP000650433 KYUNG-HEE SOHN ET AL.: "Anti-angiogenic activity of triterpene acids" * the whole document *	5-9	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
X	--- WO-A-95 04526 (GLYCOMED INC.) * page 7 - page 8; claims 1-8 *	5-9	A61K
Y	--- WO-A-94 05152 (GLYCOMED INC.) * claims 1-5,12 *	5-9	
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 7 February 1997	Examiner Tzschoppe, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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Application Number  
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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Y	ANN.N.Y.ACAD.SCI, vol. 732, 6 September 1994, pages 263-272, XP000650511 ERIC P. SIPOS ET AL.: "Inhibition of tumor angiogenesis" * page 263, paragraph 1 * * summary *	5-9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 7 February 1997	Examiner Tzschoepe, D
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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